THE USE OF LIFE HISTORY STRATEGIES OF MICROARTHROPODS IN GRASSLAND MANAGEMENT.

H. Siepel & C.F. van de Bund, Research Institute for Nature Management, P.O. Box 9201, 6800 HB Arnhem, The Netherlands.

Introduction.

Microarthropods may be useful indicators in nature management (Karg, 1982). The use of microarthropods in nature management however presents some practical problems. First there is a high number of species to deal with. The second problem is the identification of the species. Many species are recognized by specialists only. In this paper we will try to bypass these problems for a substantial part. We propose to combine microarthropod species in groups based on the similarity of their life history strategies. This aim might be achieved in two ways. First by clustering the species, using a list of several life history traits per species (Bink & Siepel, 1986). Although this method is ideal for small groups of species, for the large number of microarthropods it is not practicable because the assemblage of data will be too digressive. A second method is the use of a theoretical concept on life history strategies. We have chosen the theoretical concept of Stearns (1976).

Life history traits.

From the large number of life history traits reviewed by Stearns (1976), we present here a number of traits concerning microarthropods: diapause forms, reproduction, semelparity, iteroparity, parthenogenesis and phoresy. Diapause forms, resulting in synchronisation with the period of abundance in food supply, are found in microarthropods mainly in Sminthuridae (Davies 1928), Eupodidae and Tetranychidae (Jeppson et al. 1975). Egg production among microarthropod species differs greatly (Dunger 1963). Next to the number of eggs, the variation in production time is important. It varies from semelparity in some Pyemotidae (Krczal, 1959; Kosir 1975) to forms having more or less iteroparity such as Tetranychidae (Jeppson et al. 1975, Blair & Groves 1952). Maximal iteroparity in microarthropods can be found in species having a long adult life time like Neoribates gracilis (Travé & Duran 1971). Two more life history traits seem important in microarthropods: parthenogenesis and phoresy. Having the ability of parthenogenesis might be favourable in colonizing new sites. So it is to be expected that parthenogenesis is associated with a high capability of dispersal for instance phoresy. That combination is found in some Macrocheles species (Filipponi 1955, Pereira & de Castro 1974) but it is in general rather rare. At the other hand, parthenogenesis is common in euedaphic species having a low capability of dispersal. This seeming contradiction is explained when parthenogenesis is split up in arrhenotoky and thelytoky. The first is favourable for colonizing, the second is found among euedaphic species resulting in clones. Arrhenotoky might be allied to phoresy, we found only one example of thelytoky allied to phoresy (Olodiscus minimus, Athias-Binche 1981). A problem in distinguishing life history strategies is the lack of data. For only a relatively small number of species all summarized life history traits are quantified. So we try to fit species or groups of species into an existing classification. It might happen that species at this moment will be placed in the wrong group because of lack of sufficient data. This classification must be considered as a first draft where upon additions and modefications are welcome.

Life history strategies.

Stearns (1976) distinguished three main life history tactics: species

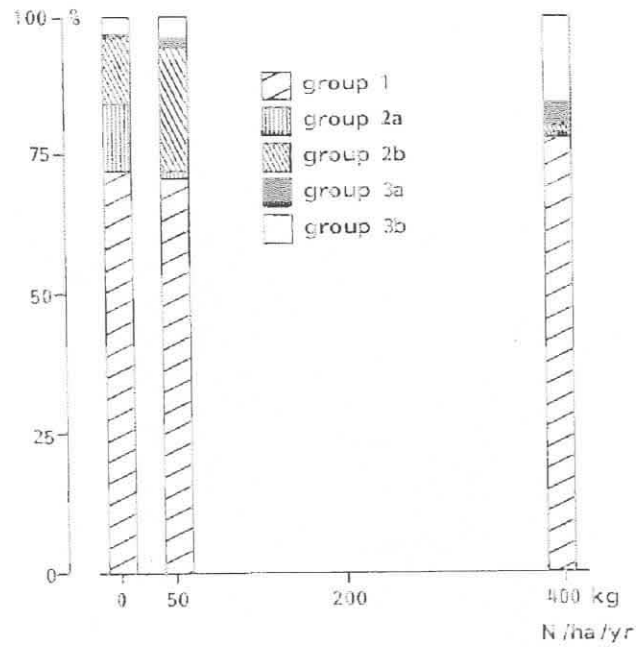

Fig. 1. The fraction of Acari per life history strategy plotted against the N fertilization level in grasslands. See text for explanation of the groups.

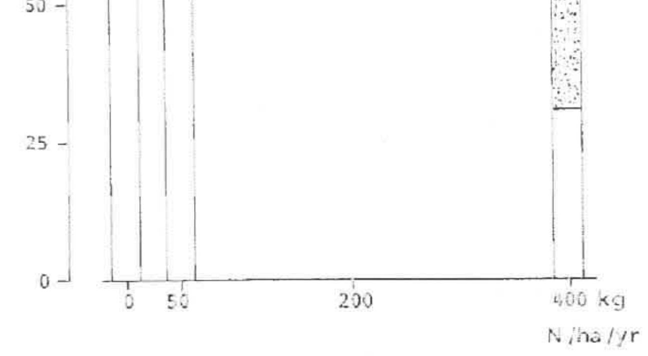

Fig. 2. The fraction of Collembola (part of life history group 1) per life form plotted against the N fertilization level in grasslands.

living in an environment having: 1. a cyclic period where species life time is shorter than the period concerned; 2. a cyclic period where species life time is equal or longer than that period and 3. in time randomly accessible habitats. Group 1 comprises species having several generations per year, in this group diapause forms occur. Group 2 is split up in four parts by Stearns (1976); of these parts only one seems applicable to microarthropods (start of the cyclic period predictable and the course of the period predictable within limits). This group is divided by us in species having a life time longer than the period (2a) and species having a life time about equal to the period (2b). Species of subgroup 2a may survive better in an incidental bad year. In group 3 species are found adapted to survive in random accessible habitats. These species have to be very mobile (for instance phoretic) and also arrhenotoky may occur. This third group is divided into a group of species only phoretic in a juvenile life stage (3a) and a group of species mainly phoretic in the adult life stage (3b). The first group of species has first to moult before reproduction is possible. The last group including some species with arrhenotoky is ready to colonize a habitat immediately. Species being phoretic in a juvenile stage leave the substrate in great numbers. In that case several individuals cling to attach the same animal as transport medium. Probably therefore arrenotoky is less urgent than in species being phoretic as adult, which migrate alone or with few.

Life history strategies of microarthropods.
All Collembola, the majority of Prostigmatic mites and a great part of the Mesostigmatic mites are to be found in group 1, because all these species have several generations per year. The year is concerned as the cyclic period. In group 1 several Cryptostigmatic mites are also found: the families Oppiidae, Brachychthoniidae and the genus Tectocepheus because of their relatively fast development (potentially more generations per year: Luxton 1981). The Collembola of this first group are divided in three life forms: epedaphic, hemiedaphic and euedaphic (Gisin 1943). For Acari this classification is less prominent. Group 2 comprises mainly Cryptostigmatic mites. In group 2a (life time 1,5 year or longer) are found: the genera Camisia, Nothrus, Platynothrus, Damaeus, Trichoribates, Ceratozetes, Steganacarus and Rhysotritia. In group 2b (life time about 1 year) are found for instance the genera Liebstadia, Xenillus, Galumna, Minunthozetes, Scheloribates and Bryobia (Prostigmata). Group 3 comprises species adapted to survive in random accessible habitats. Most of these species are phoretic. In group 3a (phoretic only in the juvenile stage) are found the genera: Tyroglyphus, Rhizoglyphus, Histiostoma, Parasitus and several Uropodidae, such as Fuscuropoda spp. In group 3b (phoretic in the adult life stage) are found for instance the genera: Macrocheles and Alliphis.

Microarthropod life history strategies and grassland management.
Using the data of Siepel & van de Bund (in prep.) in this theoretical classification leads to remarkable results. In fig 1. the fraction of Acari per life history strategy (total Acari present is 100%) is plotted against the N fertilization level of the grasslands. The decrease of group 2 in favour of group 3 along this axis is striking. Group 1 has about the same fraction at every fertilization level. Within group 2 especially group 2a appears to decrease with increasing N fertilization level and attendant disturbances. This group contains the species with the longest development times. Group 3a and 3b increase both with increasing N fertilization level, but the increase of group 3b is more pronounced. This group occurs hardly in unfertilized grasslands.
The life forms in Collembola (life history group 1) show a bigger epedaphic

group at higher N fertilization levels (fig. 2) at the cost of the euedaphic species, having a higher turnover rate than euedaphic species do (Van Straaten et.al. 1985).

Conclusion.

In Acari we observe with increasing N fertilization levels a greater part of mites having a very short generation time, using short existing habitats, and a smaller part of mites having long juvenile development times. In Collembola the number of individuals having a high turnover rate is greater at high N fertilization levels. In both groups fertilization is in favour of rapidly reacting species at the cost of species with longer development times. This leads to a high dynamic of the soil ecosystem and might lead in some situations to destabilization. The study of life history strategies of microarthropods seems a proper way in reviewing existing situations in grasslands. A detailed elaboration of the system may provide a review of other management practices as well.

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